Increased Accuracy through Retrofit

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Content

- Part I **Required Capabilities**
  - General Requirements
  - Possible Solutions
- Part II **System Description of 1-D TCF**
  - Posing the Problem / System Analysis
  - System Requirements / System Approach
  - Performance / Tactical - Operational Benefits
  - Results of successful System Demonstration on 26 June 2001

Required Capabilities

General Requirements

- **Accuracy before Range (combinedness)**
  - Gun Artillery up to 40 km
  - beyond 40 km Rocket Artillery, Fighting Drones
- **increase Accuracy to**
  - lower number of rounds to defeat targets
  - reduce logistic burden
  - destroy pinpoint targets
  - minimize collateral damage

Required Capabilities

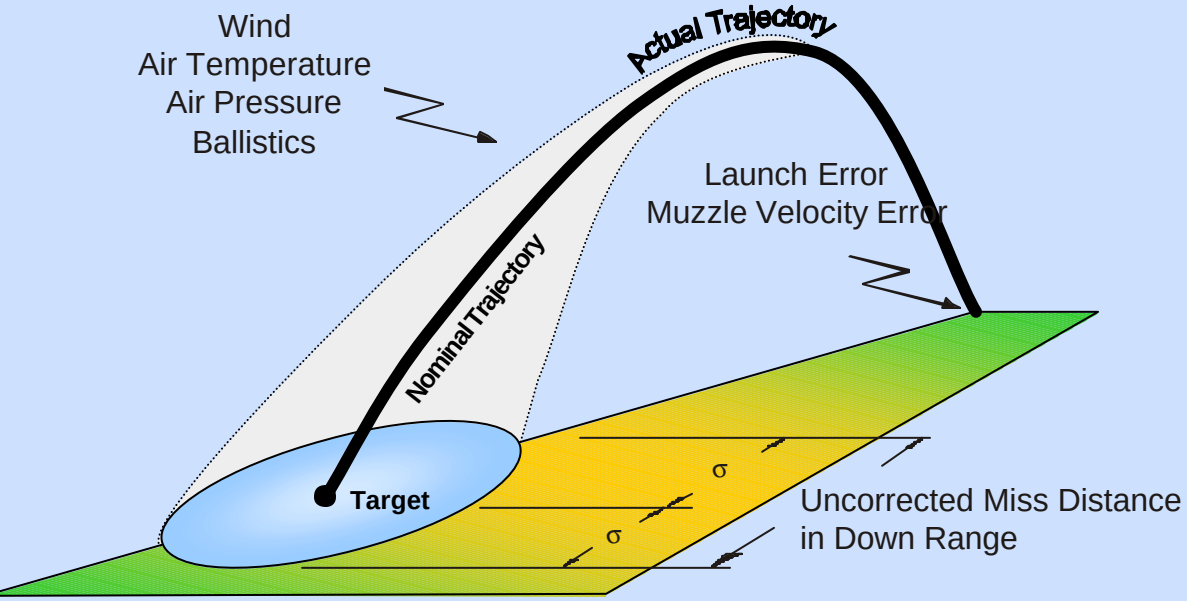
Possible Solutions

- **GPS Guided Ammunition**
  - realization feasible
  - cost, time and technical risks to be minimized
  - General Staff prepares decision document

- **LCCM Ammunition**
  - Course Correction Fuze for conventional Ammunition

1-D Trajectory Correction Fuze (TCF)

1-D Trajectory Correction Fuze (TCF) Posing the Problem / Technical Approach



Active Trajectory Correction (1 D

- **Sensor Task**

  Detection of Actual Trajectory Variation

- **Control Actuation Task**

  Well-Aimed Trajectory Correction

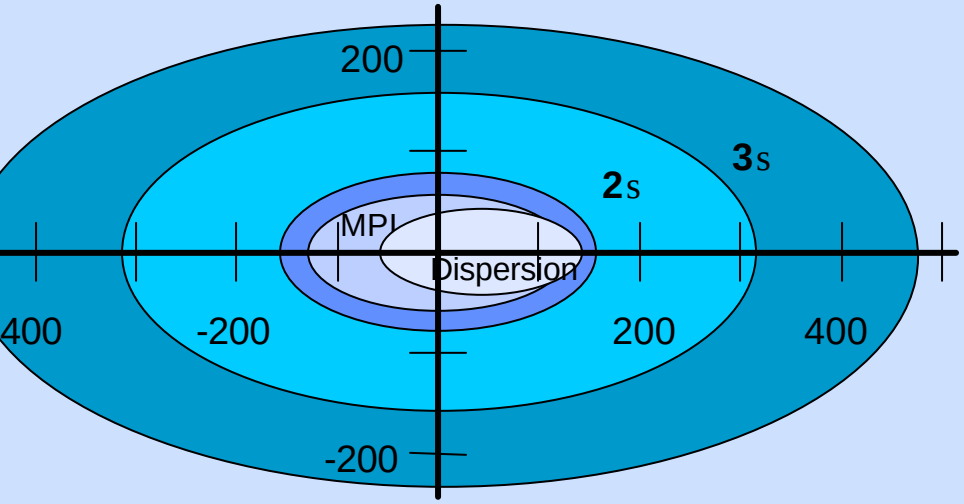
- **Algorithm Task**

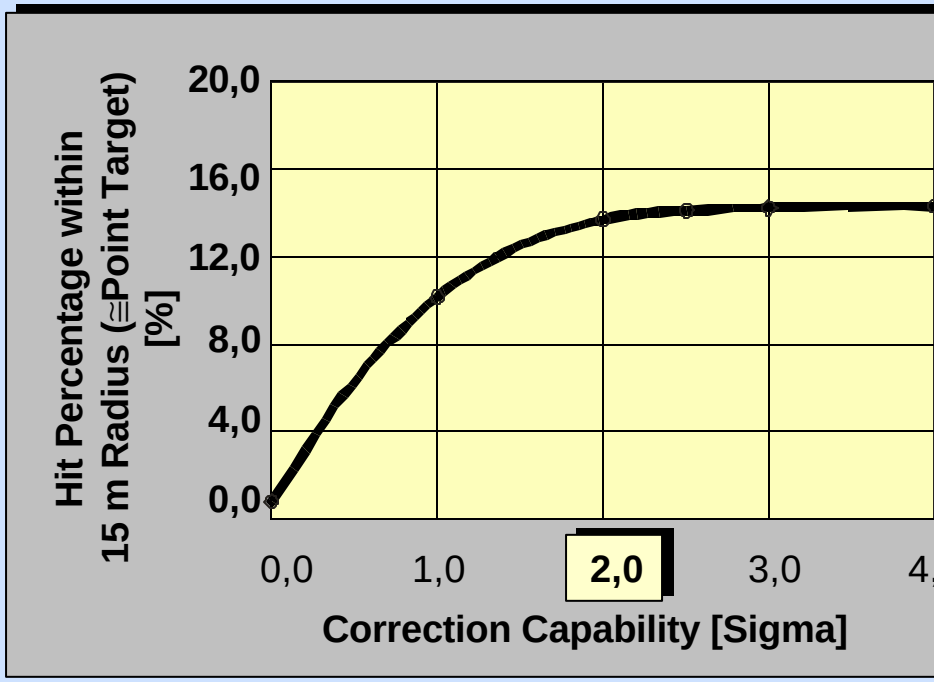
  Calculation and Coordination of optimal Drag Brake Deployment

1-D Trajectory Correction Fuze (TCF)

System Analysis / Required Correction Capability

R = 27 km





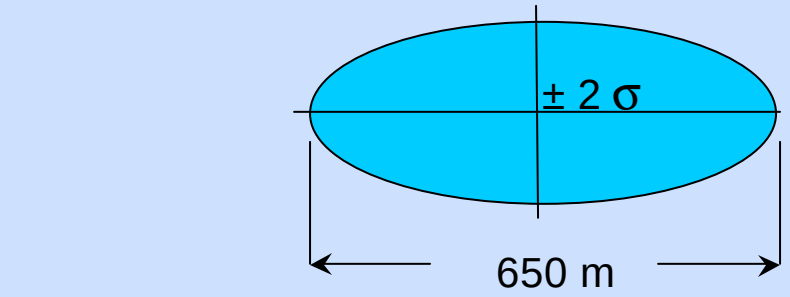
Miss Distance

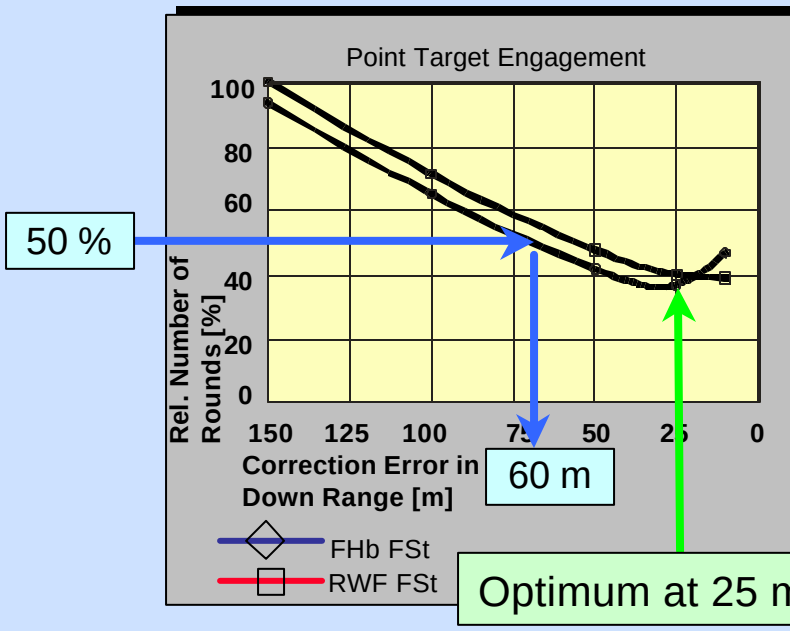
Optimal Correction Capability

1-D Trajectory Correction Fuze (TCF)

System Requirements

- Maximum Correction Capability of **± 2** s = **650 m** Required
- Induced Error in Cross Range is Neglectible
- Optimum Correction Error in Down Range Resulting for 1 σ = 25 m
- Halving of Number of Rounds Achievable for **1** s **< 60 m**





1-D Trajectory Correction Fuze (TCF)

Sensor / Control Actuation Approach

- **Sensor Options**
  - Onboard GPS
    - Accuracy **independent of Range**
      8 m, 0.1 - 0.5 m/s (1 σ)
    - **Fire & Forget** Solution
  - Groundbased Radar and Uplink
    - Accuracy **dependent of Range**
      25 m, 0.05 degrees up to 15 km (1 σ)
    - Munition **Tracking necessary**
    - **Longer** Stay at Firing Position

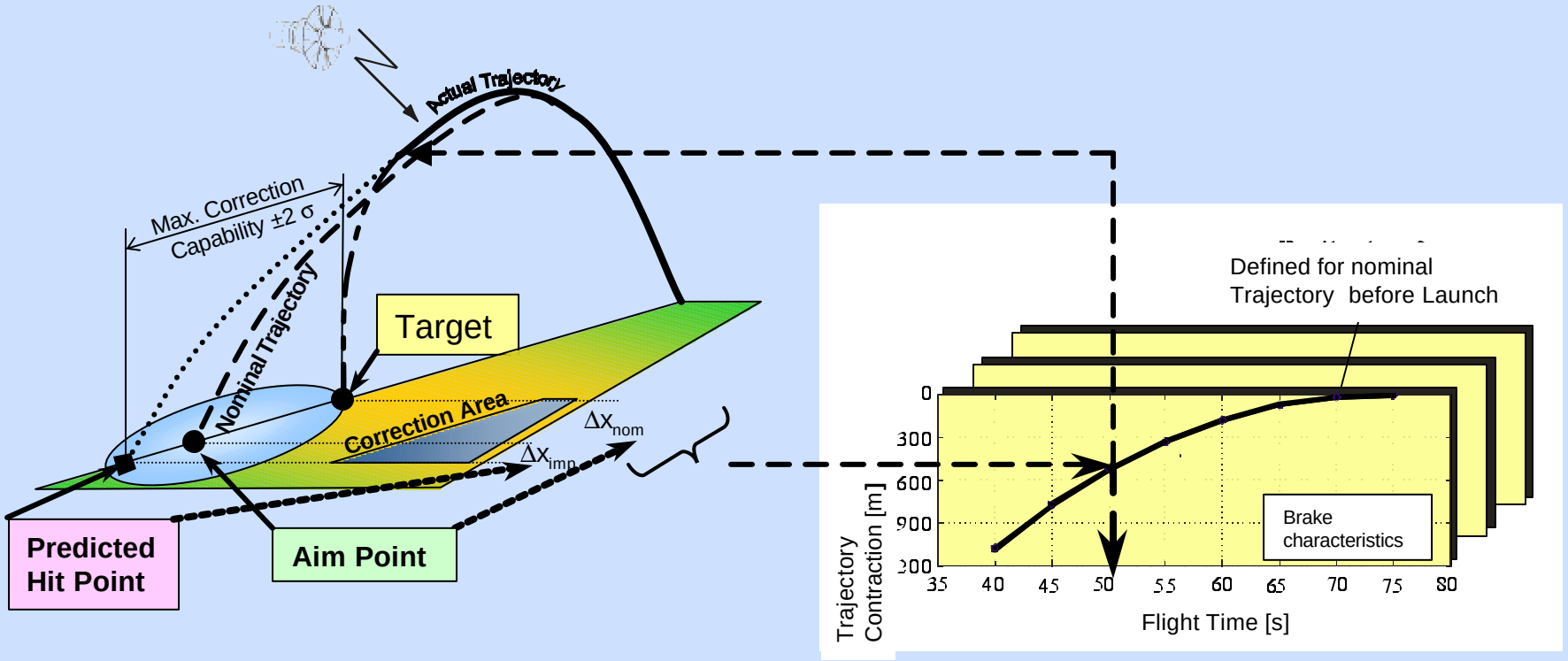
- **Control Actuation**
  - Simple Mechanics
    - no moving parts
    - no servo required
  - Control
    - **time discrete**
    - constant force
  - Effectiveness
    - **time variable**
    - integral effect dependent on time of flight
    - limited to down range shortening (1 D)

GPS - the most Cost and Mission effective Solution

Trajectory Correction by Drag Magnification

1-D Trajectory Correction Fuze (TCF)

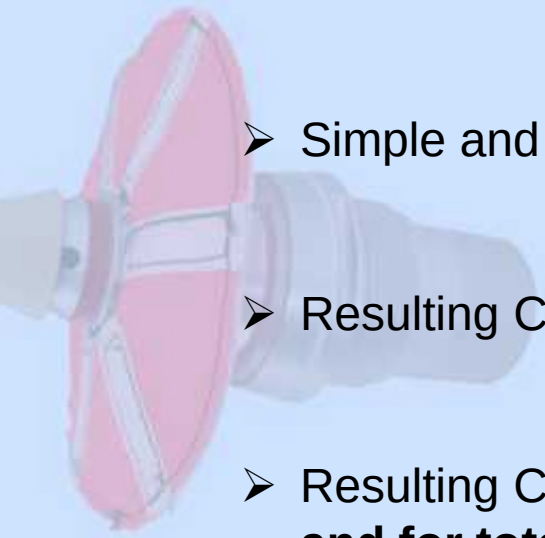
Correction Algorithm Task



Hit Point Prediction required for
Optimal Drag Brake Deployment

1-D Trajectory Correction Fuze (TCF)

Performance



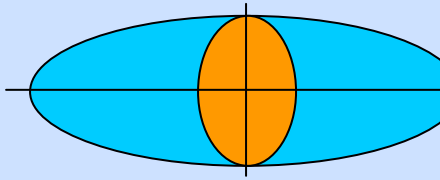
- Simple and robust Algorithm
- Resulting Correction Error for Ideal **GPS Performance** ~ **25 m**
- Resulting Correction Error for noisy **GPS Performance**
  and for total GPS Deficiency at 10 km from Target Position ~ **40 m**

Halving of Number of Rounds achievable even under severe Jamming Conditions for GPS

1-D Trajectory Correction Fuze (TCF)

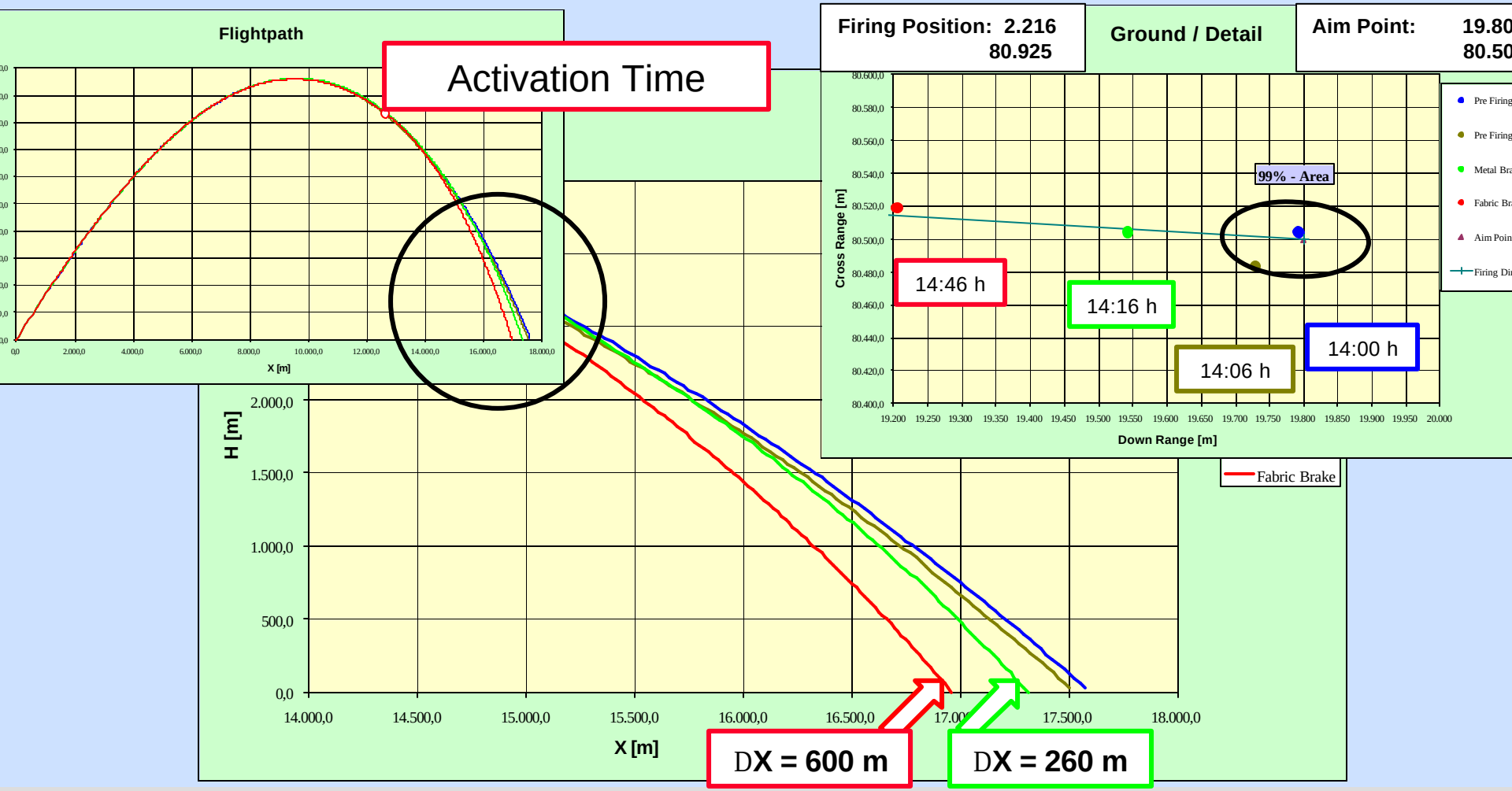
Tactical - Operational Benefits (HE-Round)

- Reduced Number of Rounds for Target Kill by Factor **2 - 2,5**
- Reduced Cost / Kill by Factor **2**
- Reduced Area of Miss Distance (Collateral Damage) by Factor **4,5**
- Reduced Target Engagement Time
- Reduced Stay at the Firing Position
- Reduced Logisitic Burden



Successful Demonstration of TCF

26 June 2001, WTD 91, Meppen



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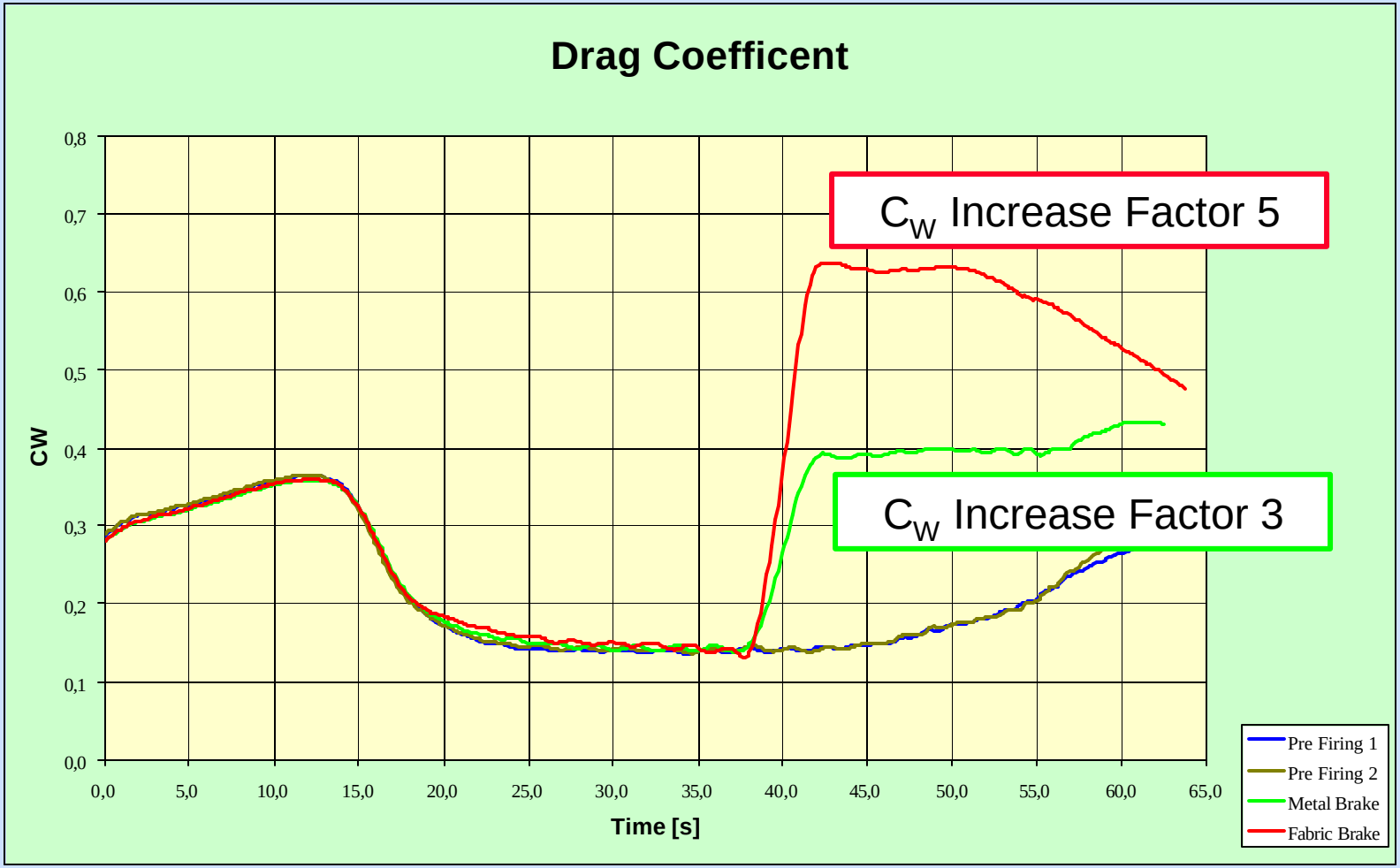
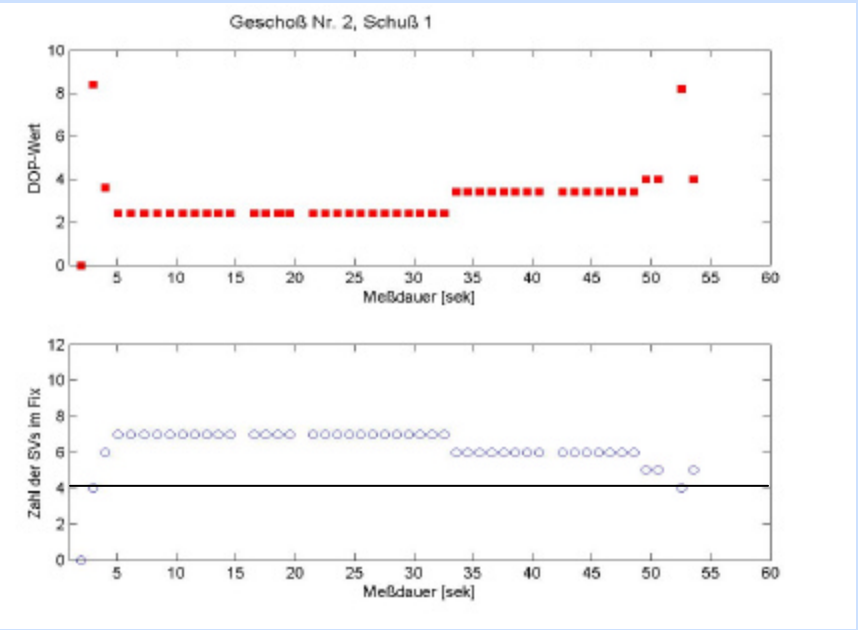
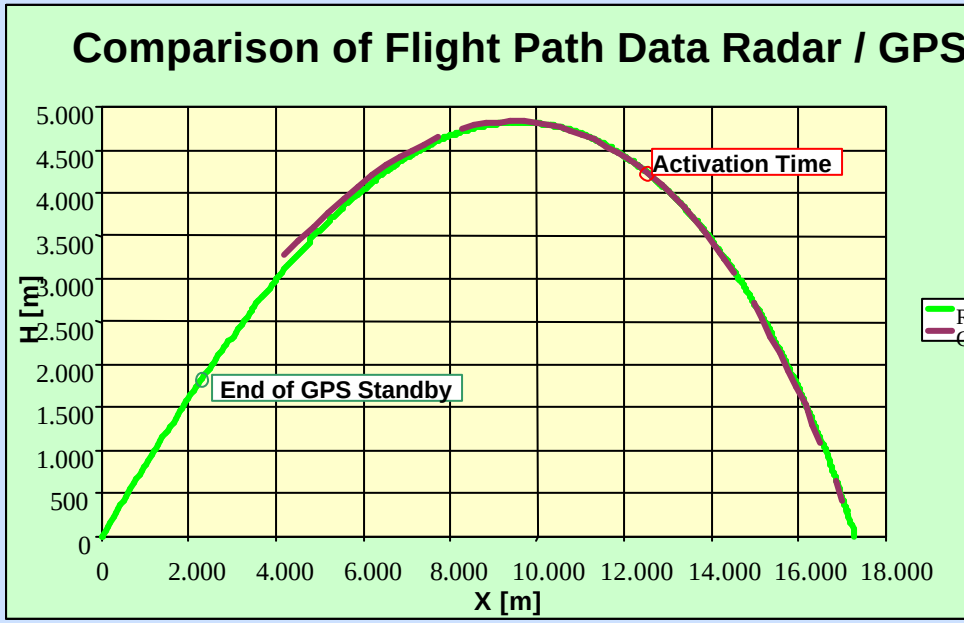


Successful Demonstration of TCF

GPS Reception

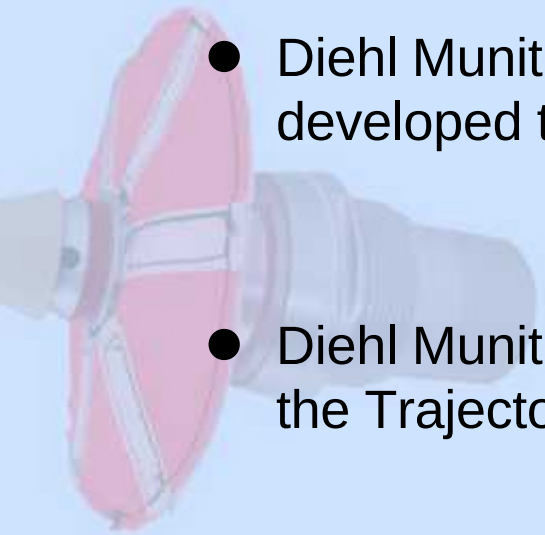




- **4** Satellites as a Minimum for Calculation required
- **7** Satellites for Calculation mostly available

Summary

- Diehl Munitionssysteme and Junghans Feinwerktechnik have developed the TCF concept under contract of the German MOD
- Diehl Munitionssysteme has **successfully demonstrated** the Trajectory Correction Module under contract of the German MOD
- Diehl Munitionssysteme and Junghans Feinwerktechnik are ready to enter the full scale development phase of TCF



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Thank you for your attention

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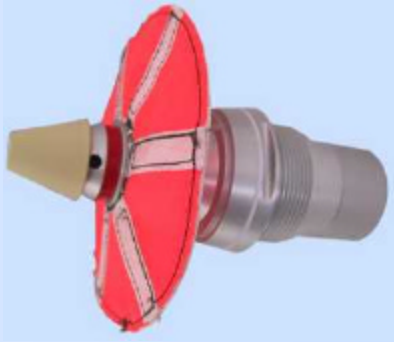

QUESTIONS ?